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Methods of Testing School Children for Defects of Vision and Hearing

By

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METHODS OF TESTING SCHOOL CHILDREN FOR DEFECTS OF VISION AND HEARING

By

Harvey A. Peterson, Ph. D.

One of the four or five most important fases of educational progress at the present day is the more efficient care of the helth of children by the school authorities. The working out of this ideal has taken a number of forms according to the needs of children in their relation to the school. Thus we have medical inspection, improved school and personal hygiene, the playground movement, and mental tests of intelligence with special classes for subnormal children. It is the purpose of this bulletin to deal with a part of medical inspection with which, in the present stage of the movement, teachers have a good deal to do, and for which in many places they are responsible. I refer to tests of the sight and hearing of children.

Medical inspection of schools is growing in public favor with remarkable rapidity. According to an investigation made in 1911 by the Russel Sage Foundation and reported by Gulick and Ayres in their *Medical Inspection of Schools* there were in 1894 four cities which had medical inspection; in 1899 there were nine; in 1904, thirty-seven; in 1909, two hundred and sixty-three; and in 1911, four hundred eleven. Thirty-two more cities had medical inspection but did not report when it had been establisht. It is safe to say that in 1911 not far from forty per cent of all

the cities in the United States had medical inspection. Tests of sight and hearing are always included in medical inspection and along with the examination of nose, throat, and teeth, are regarded as the most important part of the inspection. Indeed the tests of sight and hearing are older and much more widely establisht than the other examinations mentiond; for while 443 cities had medical inspection, 810 out of 1038 had tests of sight and hearing.

In such movements as this, city school systems nearly always take the lead. Yet the movement is well under way in the state systems. According to the same report seven states required medical inspection in all their public schools in 1911. They were Colorado, Indiana, Maine, Massachusetts, Minnesota, Rhode Island, and Utah. Thirteen more had past laws permitting school funds to be used for medical inspection. Permissiv laws in such matters usually become mandatory before long. It is not the purpose of this bulletin to go into the reasons for and against tests of sight and hearing by the school. The same reasons which justify education by the state justify whatever conditions are necessary and proper to secure it, providing it can be shown that the school can provide the conditions more efficiently than the parents, or that providing the conditions free for some children and not for others is contrary to our democratic ideals. School tests of sight and hearing are necessary because in many cases neither the children nor their parents, unaided, are likely to discover the defects for years. Many parents need the stimulus of a note from the principal or school physician to induce them to take their children for treatment.

When the tests are made by physicians undoutedly they are more reliable than when conducted by teachers. Possibly when public opinion is sufficiently educated, physicians will do most of the work. At the present time, however, particularly in the rural and small town schools of Illinois, public sentiment is not strong enuf to support free medical inspection. Meanwhile it is possible for the teacher to be of great servis. With very little training, even such as this bulletin provides, he can discover the children whose sight or hearing is sub-normal, determin how serious the

defect is, and if serious enuf, advize the parents to consult a physician. Aside from the great improvement in school work which usually results, this is one of the most effectiv ways of developing a sentiment in favor of medical inspection. Even after this is secured, in many places the teacher continues to make the preliminary examination, in order that the children who need attention may not be obliged to wait on the necessarily slow progress of the physician's systematic examination of the whole school. The oculists and aurists whom the Massachusetts legislature consulted in framing their law on the subject advized that the annual tests of vision and hearing be conducted by the teachers. Gulick and Ayres approve of this in their recommendations to those who are contemplating legislation. According to their investigation teachers test the sight and hearing in 552 out of 810 cities, and in five of the seven states requiring these tests.

I have shown that medical inspection with the teacher as an assistant is growing rapidly. In the Elementary Training School of the Illinois State Normal University the sight and hearing of the children have been tested annually for the last three years. In the examination a year ago forty children, which is ten per cent of the enrolment, were found seriously enuf defectiv in sight to warrant recommending to the parents that a professional examination be made. During the next twelve months the parents of fifty per cent of the children acted upon the advice and had a professional examination made. According to the teachers much benefit has resulted both in helth and in the efficiency of the children's work. Glasses were secured by many, treatment given, and further damage by use of the eyes in improper condition has been prevented. *Is it not worth your while to acquire the ability and start such tests in your school?* We shall next describe how to procede in initiating the work.

1 METHOD OF TESTING SIGHT WITHOUT LENSES

The work requires a room well lighted and long enuf to enable the person tested to sit six meters, or twenty feet, from the charts. A Lowell letter chart and a Verhoeff astig-

matic chart are also needed. These may be obtaind at small cost from the supply houses mentiond at the end of this bulletin.

Place the charts in a good light on a level with the child's eyes when seated. The light should come from the side or rear of the child; if the latter, there should be no glare in his eyes. Direct sunlight should not be used. If an artificial light has to be used, place it near the charts, avoiding glare, and tying a piece of cardboard in front of it to shield the child's eyes. If there are other children waiting to be tested, seat them far enuf away to prevent their hearing the reading of the letters.

Seat the child twenty feet from the charts and cover his right eye with a bandage. If he wears glasses test him with them on, tying a cardboard blind over the right eye and slipping it down inside the glasses, taking care that it does not interfere with winking. Tell him to read the letter chart from left to right, beginning with the line numbered 8. If he can read all of this correctly, record the vision of the left eye as normal. If he misses a letter he should procede to the next coarser line, and so on, until he can read a line without any errors. The fraction opposit this line on the left side of the chart indicates his fraction of normal vision, 8-10, 6-10, etc., and should be recorded.

Now test the same eye for astigmatism. Ask the child to look at the astigmatism chart, and tell whether some of the radiating lines appear clearer and blacker than the rest. If so, astigmatism is present, and the diameter of greatest clearness indicates the type of astigmatism. Vertical astigmatism is the most common type. Record the diameter of greatest clearness, using the numbers around the rim of the chart. If all the lines are blurd, have him approach the chart and record the diameter that first becomes clear.

Test the right eye in the same way. The following is a sample of the kind of records which the teacher should have: "Grade V. John Snow. Sept. 18, 1914. Left eye I. No astig. Right eye 8-10. Astig. 3-3." The I. after the words "left eye" means normal sight; the 3-3 indicates the diameter of greatest clearness in the astigmatism test.

Distinguishing hyperopia and myopia without lenses.—

It is desirable, but not necessary, for the teacher to be able to distinguish hyperopia (far-sightedness) and myopia (near-sightedness) from each other, in order to give the child a favorable seat until he obtains glasses. The best way to distinguish them is with the aid of lenses, as described in the next section. Lenses are moderately expensiv, but easy to use for this purpose. Extreme hyperopia and myopia can often be distinguisht by the distance at which the child holds his book. The normal distance is about twelv to fourteen inches. The extremely myopic child holds the book nearer, the extremely hyperopic child, farther away.

If astigmatism is shown by the Verhoeff chart to be absent, inability to read ordinary writing on a blackboard twenty feet away indicates myopia, while hedake and inflamed eyelids indicate hyperopia. If the child is near-sighted seat him near the blackboard until glasses are secured, and perhaps even afterwards, as glasses cannot always entirely correct the defect. If he is far-sighted, give him as little fine work at close range as possible until glasses are secured.

Squint.—Squint is of two varieties, internal and external, the internal being commonly known as "cross-eyedness." The internal form is due to far-sightedness, the extreme effort at accommodation which the far-sighted person makes bringing with it reflexly an extreme convergence. External squint is similarly due to near-sightedness. In case there is a doubt as to whether a child squints, cover one eye, have him fixate something with the other eye, and notis whether his line of vision changes as the covered eye is uncovered. If so, there is squint. The defect is one which should be remedied early because, if allowd to continue, the eye affected becomes blind. The teacher should consequently always advize treatment.

II. METHOD OF TESTING SIGHT WITH LENSES

As above stated this is the easiest and most satisfactory way of distinguishing hyperopia and myopia. A trial frame (lens holder) and set of lenses can be procured for $9.00 from the supply houses (See last page). The procedure is

the same as the test with charts alone except that a solid disc put into the trial frame takes the place of the bandage or cardboard blind. If the person's sight is shown by his reading of the letter chart to be sub-normal (less than 1), the convex lens (nickel-rimd, markt plus 75) should be tried. If it aids vision, or does not impair it, the eye is far-sighted. If the concave lens (copper-rimd, markt minus 75) aids, the eye is near-sighted.[1] Put the trial frame on the child, cover the unused eye with a solid disc, clean the lenses, put one of them into the frame. Then adjust the set screws so that the pupil of the eye is opposit the center of the lens. Have the person read the chart again, and record the result. Both the ability to read finer print with the lens than without it and the testimony of the person as to whether the print is clearer or not are useful in deciding whether he is improved; *but the former is the chief reliance.*

If the vision is defective but neither lens aids, the defect is something else than myopia or hyperopia, and should be recorded as "Neither." A far-sighted person can, however, pass the test (read the 8th line) by a very strong contraction of the ciliary muscle. This is cald latent hyperopia, and is not easy for the teacher to detect. The oculist uses drugs to paralyze the ciliary muscle temporarily.

COMPARISON OF THE LOWELL AND SNELLEN TEST CARDS

By some examiners Snellen's chart is used. The distance at which each line of the chart can be red by the normal eye is given, and if the forty-foot line is the smallest print that the person can read at twenty feet, his vision is said to be 20-40 of normal, if the sixty-foot line is the smallest print, 20-60 of normal, etc. In principle this chart is the same as the Lowell chart recommended above. The eighth line in the Lowell chart and the twenty-foot line in the Snellen chart are the same size print, viz., the smallest print that the normal eye can read at twenty feet. Now the linear size of an object decreases directly as the distance

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[1] Another way of distinguishing convex and concave lenses is to move them up and down over print. The print moves *with* the concave lens and in the direction *contrary* to the convex lens.

increases, that is to say, at twice the distance the object appears only one-half as high or wide. Consequently in order for letters on the Snellen card to be read by the normal eye at forty feet, they hav to be twice as large in linear size as at twenty feet. Now if the forty-foot print is the smallest that the person being tested can read at twenty feet, his vision is only one-half or 20-40 normal. The Lowell chart calls this forty-foot print 5-10. The 100-foot print on the Snellen chart and the 2-10 on the Lowell chart are of the same size, and the 200-foot line on the former corresponds to the 1-10 on the latter. The other lines on the two charts do not correspond in distances chosen.

It is unnecessary and undesirable in using either chart to try the child at other distances than twenty feet, except in the case mentiond above where all the radiating lines of the astigmatism chart appear blurd. One cannot distinguish myopia and hyperopia from each other by this means.

SIZE OF PRINT

It is a matter of much importance for teachers to know the size of print in which children's books should be printed. The following quotation from Dr. A. G. Young's Seventh Annual Report as Secretary of the Maine State Board of Helth, given in Dresslar's School Hygiene answers the question.

> Books printed from type smaller than "long primer" should never be put into the hands of pupils of any grade, and those for young children should be printed from "pica" or "great primer". Full-faced roman type is much more suitable than the "light-faced" type now so much in favor.
>
> The distance of the letters from each other should not be too slight and the different words in the same line should stand far enuf apart to enable the eye rapidly and easily to take in the picture of each. The distance of line from line should not be less than 2.5 millimeters, disregarding the longer letters, and Cohn prefers three millimeters (⅛ inch). When lines are of too great length, the eye has a difficulty in running back to the beginning of the next line. Some authorities state that the length of line should not excede 100 millimeters (3⅞ inches); others, as appears to me more wisely for schoolbooks, place the limit at 80 or 90 millimeters (3⅛ or 3½ inches).

PEARL, as the printers call it, is unfit for any eyes, yet the piles of Bibles and Testaments annually printed in it tempt many eyes to self-destruction.

AGATE is the type in which a boy, to the writer's knowledge, undertook to read the Bible thru. His outraged eyes broke down with asthenopia before he went far and could be used but little for school work the next two years.

NONPAREIL is used in some papers and magazines for children, but to spare the eyes, all such should, and do, go on the list of forbidden reading matter in those homes where the danger of such print is understood.

MINION is read by the helthy, normal young eye without appreciable difficulty, but even to the sound eye, the danger of strain is so great that all books and magazines for children printed from it should be banisht from the home and school.

BREVIER is much used in newspapers, but is too small for magazines or books for young folks.

BOURGEOIS is much used in magazines, but should be used in only those school books to which a brief reference is made.

LONG PRIMER is suitable for school readers for the higher and intermediate grades and for textbooks generally.

SMALL PICA is still a more luxurious type, used in the North American Review and the Forum.

PICA is a good type for books for small children.

GREAT PRIMER should be used for the first reading book.

TESTS OF HEARING

There are two tests of hearing in common use: the watch test and the whisperd-speech test. Since the work of Andrews in 1904, in schools the whisperd-speech test is coming into general use. Rapeer in an examination of medical inspection in twenty-five cities in New York and New England found that the whisperd-speech test was the one most commonly used. Andrews found that in bildings the intensity of sound does not decrease in proportion as the distance increases, on account of the reflexion of sound waves across the room. In the room which he used hearing was as good at fifty feet as at forty feet and as good at eighty feet (near the back wall) as at sixty-five feet. In the watch test the method consists in finding the greatest distance at which persons of normal hearing can hear a certain watch tick, and then finding what part the extreme range of the person being tested is of the extreme range for normal hearing. The tests of Andrews showd that it is un-

safe to infer that because I can hear a watch tick at two-thirds the distance that persons of normal hearing can, my hearing is two-thirds as good.[1] In the whisperd-speech test, series of two-figure numbers are whisperd to a person seated a certain distance away, and the quality of his hearing is judged by comparing the percent of numbers which he hears correctly with the percent obtaind by persons of normal hearing. Thus the range is kept constant. There are other reasons for preferring the whisperd-speech test to the watch test. The rich variety of sounds in speech make the hearing of a watch-tick an unreliable indication of ability to hear speech. The whisperd-speech test is better suited to group work. On the other hand the strength of the tick at a fixed range is constant, while it takes quite a little practis to produce a whisper of constant strength. All things considerd the speech test is much to be preferd for school work.

TESTING HEARING BY WHISPERD-SPEECH

We shall first describe the method of testing children of the four upper grades and those older, and then speak of the modifications necessary for younger children.

1. *Establishing the range.*—The purpose of this part of the test is to find a distance such that persons of normal hearing can hear 80-95% of all the numbers spoken to them. The only materials needed are a sounder and a small supply of rubber corks number 00 which may be obtaind from the supply houses. The kind of place best suited for tests of hearing is a room or hall upwards of fifty feet long, quiet within and without. The range may be shortend by the use of screens or by the speaker's standing in an adjoining room with the connecting door open, or one may cultivate a faint whisper. By these means the ordinary recitation room can be used; *but there should be no children in it besides those who are being tested.* Select ten children who are supposed to be of normal hearing and seat them at one end of the room, one behind another with their left ears toward the examiner. Arrange them

[1] Directions for the watch test may be found in Whipple, G. M., Manual of Mental and Physical Tests, 2nd edition, 1914, Pt. I, p. 207.

in an arc of such radius that those at the ends will be no farther away from the speaker than those in the middle. Supply them with paper and pencil, arm-rests or books on which to write, and rubber corks. Then give them the following directions.

"I am going to whisper to you some numbers, and after each number I shall ask you what it was. Do not write at present. Keep your faces to the front and mouths closed. A click with the sounder is a signal that the number is coming [here the examiner should illustrate]. Now close the right ears with the rubber corks."

The examiner should now take a position thirty feet from the children, click the sounder, make one normal respiration (in and out), whisper a number with residual breth, and then ask each child in turn to say what the number which he heard was, if any. He should then move closer or farther away according as the percentage of correct answers is too low or too high. If the room is thirty feet or less in length, insted of varying his position the speaker must raise or lower his whisper or resort to the other expedients mentiond above. If there are ten children each correct answer is worth ten and each one-half correct, five. From the point of view of spoken speech *seventeen* for *seventy* is half correct, but *seventy-three* for *twenty-seven* is probably worth nothing. If seven children answerd correctly and three half correctly, the percentage for that number is 85%. Find a range such that four or five numbers in succession run between 80 and 95% correct. Then test it thoroly by giving the test with sixty numbers, now to be described. If most of the group—say, seven or eight—average between 80 and 95% with each ear, the range may be adopted provisionally, subject to such modification as later experience warrants.

2. *Testing children of the upper grades: group test.*—This test consists in giving thirty numbers, in series of ten, to each ear. As many as eight persons may be tested at once. The numbers should be red in the following way: 1 click with the sounder as a warning signal followd by 1 respiration and a number ; 2 clicks to indicate that the number has been spoken followed by 2 respirations, which

is the time allowd for writing; then 1 click again, etc. Let the children rest one minute with corks removed after each ten numbers, and three minutes after each third series. After thirty numbers have been spoken to the left ear, have the children face about and test the right ear in the same way. The directions are as follows:

"I am going to whisper thirty numbers to you as a test of the hearing of your left ear, and then thirty more to the right ear. Write your name in full, your grade, and the date in the upper right-hand corner of the sheet of paper. On the left half of the first line write Left ear, and on the right half, Right ear. Across the second line under the words Left ear write the Roman numerals I, II, III, an inch apart. Under the words Right ear write the numerals IV, V, VI. The sixty numbers which I am going to read to you are to be written in colums of ten under these numerals. At the left margin of the sheet beginning with the third line write the Arabic numbers 1 to 10. These numbers mean that the first number is to be written on the line numbered 1, the second on line 2, etc. *If you do not hear a number, write a dash and pass to the line below.* If you hear only part of a number, put it down with a dash for the other part. Do not look at me. Look straight ahed or at your paper. Now close your right ears with the corks. Keep your mouths closed."

It is well to give the children a practis series of ten numbers, having an assistant stand near them to see whether they are following directions, and that they are not copying.

Numbers for test of auditory acuity

I	II	III	IV	V	VI	VII	VIII	IX	X
6	84	19	90	25	14	8	52	73	24
29	69	53	7	13	31	93	35	41	95
42	17	34	39	46	9	27	64	16	62
87	92	28	62	7	65	60	81	95	49
53	33	97	84	54	98	15	6	57	80
94	26	45	21	70	76	74	19	38	71
70	50	72	56	91	40	36	78	20	16
35	75	60	75	83	23	49	40	89	3
18	48	3	43	68	52	82	23	64	58
61	1	86	18	92	87	51	97	2	37

Time will be saved by having printed or mimeograft blanks, and by having the next group arrive promptly after the first group has finisht. If several teachers, *or the principal and a teacher,* test the entire school, greater skill and speed will be developt. In any case the same person should call the numbers for all the children in one room, as the denominator for each child's fraction of normal hearing is the room average. Always clense the corks thoroly before using them a second time, for example, by shaking them vigorously in 90% alcohol. Children should not be told the outcome of the tests. If the hearing is sufficiently sub-normal, notify the parent in writing.

Grading the tests.—In the test with sixty numbers the grading should be done at a later time. As explaind in finding the range, allow ten for each number correct and five for each number half correct. Average the three series to the left ear, and the three to the right ear and record the two averages. If poor results are due to defness, all three series will be poor. If one or two of the three to one ear are high while the others are low, the result is suspicious. It may be due to poor attention, to not comprehending directions, to outside disturbances, or to the examiner's lowering his voice. If due to either of the last two, the series which is poor should be so with all the children in the group. Whatever it is due to, give the person another test. Retest individually all children who average 60% or below with either ear. (See individual test below.) A child's auditory acuity is judged by comparing him with the others tested under the same conditions. Thus if the averages of all the children in the room are 85% for the left ear and 83% for the right ear, and a certain child's averages are L. E. 80%, and R. E. 90%, his left ear is 80-85 or 94%, and his right ear 90-83 or 108% normal.

3. *Testing children of the lower grades: individual test.*—Children of the four lower grades should be tested individually. The range is the same as in the group test. As most children will not require over two minutes each, give the following directions to eight or ten children at once:

"I am going to test your hearing by whispering some

numbers to you. When I click this sounder [illustrate] it means attention, the number is coming. As soon as you have heard the number tell me what it is. Now stand here [placing a child at one end of the range], face this way, [showing him], close your mouth, and close your right ear with your right forefinger, putting it gently but firmly into your ear."

Have the child moisten the finger in a glass of water before putting it into the ear. Then give him ten numbers to each ear, keeping track either mentally or on a sheet of paper of the number or numbers wholly incorrect, and of those partly incorrect. At the end of each series the examiner should record the grade for that series. If it is 80% or above, ten numbers are enuf. If it falls below 80% give the child one or two more series to the same ear, until you are satisfied as to his condition. No later retest is necessary. Use the room average in determining his fraction of normal hearing for final entry in the school records.

For all children who average 50% of the room average or less with either ear a notis should be sent to the parents stating the result of the test, and advizing that a physician be consulted. The same advice should be given for all children with discharging ears, whatever the result of the test. Children who are defectiv in hearing should always be given seats which favor them. If the child is only slightly def, a seat a little forward of the center of the class is best. If he is very def, something will have to be sacrificed, and it is more important to hear the teacher than the class. As it is easier to hear a speaker if one can look at him, a seat near the inner edge of the class is better than those in the center where it is inconvenient to turn around. If the child is def in one ear only he should be seated with the good ear toward the teacher and the class.

GETTING RESULTS

The results of the tests of both sight and hearing should be entered on printed record cards, one for each pupil, with colums for the results of four biennial examinations. The card should remain in the room with the pupil, and go with

him when he is promoted. A sample card is given herewith which may be enlarged to accommodate other kinds of tests.

Record Card

Name ..... Date of birth.....

Date of Examination.....

	Grade 2	Grade	Grade.	Grade.....
Sight				
L. E. Vis. Ac.	6-10			
Hy. or My.	My.			
Astig.	No			
R. E. Vis. Ac.	5-10			
Hy. or My.	My.			
Astig.	3-3			
Squint	No			
Wears glasses	No			
Hearing				
L. E.	90%			
R. E.	80%			

Treatment recommended { Sight. Yes / Hearing

Action taken after 1 month { Sight. Glasses secured / Hearing

Remarks:

A number of school systems in this country examin the sight and hearing of all children annually, but once every other year is frequent enuf. This is more nearly in accord with the practis abroad, and has the sanction of Dr. Cornell, the Director of Medical Inspection of the Philadelphia schools. What is needed is not so much a *frequent* examination as an *effectiv follow-up system* for securing proper action by the parents. If a child's vision in either eye is 6-10 or poorer, or if astigmatism is present at all, or if he squints, if his hearing in either ear is 50% of normal or poorer, or if he has discharging ears, a notis should be sent the parents advizing them to consult a physician or

oculist or aurist. *Consultations are not cheap, and such advice should be given with caution in order to be effectiv.* If the teacher can find an opportunity to urge the matter personally, the chances of success are much greater. It is probably needless to add that tact and persistence in getting parents to act are simply invaluable in making examinations of this kind a success. To judge from the returns from ten cities, reported by Gulick and Ayers, of the cases recommended for treatment 15 to 25% were actually treated. This is where the teacher makes the examination. Where physicians make the examination, the figures are about 10% higher, and if there is a nurse or home visitor the percentage runs from 40 to 70%. If these figures are somewhat disappointing, it must be rememberd that the whole movement is very recent, and the community has to be educated. One of the usual forms of notises to parents is as follows:

IRVING SCHOOL HELTH NOTIS

Mr.....

Dear Sir:—This is to notify you that.....

.....is in need of professional

attention for defectiv.....

You are urged to consult a physician or an eye ear specialist.

Yours very truly,

Date: ....

Teacher.....Grade

The word eye or ear may be crost out when the teacher or principal fills out the notis.

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